

SPACE Abstracts

[Back to Session Profile](#)

[Click here to collaborate](#)

[Earth Observing Nanosatellite - Microwave](#)

[Dan Mamula \(NESDIS / OPPA\)](#)

[Earth Observing Nanosatellite - Infrared](#)

[David Furlong \(NESDIS / OPPA\)](#)

[Compact Coronagraph](#)

[Larry Zanetti \(NESDIS / OPPA\)](#)

[Cyclone Global Navigation Satellite System](#)

[Paul Chang \(NESDIS / STAR\)](#)

[Satellite Radar Altimetry In Transition](#)

[Walter H.F. Smith \(NESDIS / STAR\)](#)

Earth Observing Nanosatellite - Microwave

Dan Mamula (NESDIS / OPPA)

Three MIT Lincoln Laboratory nanosatellite advanced technology missions flying microwave radiometers for high-resolution atmospheric sensing are in varying stages of development. Microwave instrumentation is particularly well suited for implementation on a very small satellite, as the sensor requirements for power, pointing, and spatial resolution (aperture size) can be accommodated by a nanosatellite platform. The first upcoming mission, the Microsized Microwave Atmospheric Satellite Version 2 (MicroMAS-2), will demonstrate temperature sounding in eight channels near 118 GHz, humidity sounding in three channels near 183 GHz, and cloud ice measurements in a single channel near 206 GHz. Two MicroMAS-2 3U flight units are in development, with the first to launch in early 2017. The Microwave Radiometer Technology Acceleration (MiRaTA) CubeSat will demonstrate multi-band atmospheric sounding and co-located GPS radio occultation for cross calibration. MiRaTA will launch as a secondary payload on the JPSS-1 mission as part of ELaNa-XIV. MiRaTA is designed for a one-year mission life and will fly a tri-band sounder (60, 183, and 206 GHz) and a GPS radio occultation (GPS-RO) sensor comprising a modified COTS receiver and antenna patch array. Building upon this work, the Earth Observing Nanosatellite-Microwave (EON-MW) mission is being formulated by MIT

Lincoln Laboratory for NOAA as part of the Polar Follow-On (PFO) Program's 2017 budget request. PFO plans to extend JPSS for two more missions and provides a means to mitigate the risk of a gap in continuity of weather observations. The PFO request aims to achieve robustness in the polar satellite system to ensure continuity of NOAA's polar-orbiting weather observations. The baseline EON-MW design accommodates a scanning 22-channel, high-resolution microwave spectrometer on a 12U CubeSat platform to provide data continuity with the existing AMSU and ATMS microwave sounding systems. EON-MW will nominally be launched into a sun-synchronous orbit for a two to three year mitigation mission in 2020 that will also demonstrate advanced miniaturized microwave sounder technology that expands on the capabilities developed for MicroMAS-2 and MiRaTA. Key EON-MW planned features include a pair of compact single-reflector radiometers that permit the entire microwave sounding payload to be developed with a total mass of approximately 4 kg while maximizing antenna aperture for optimal spatial resolution. The spacecraft bus is approximately 16 kg, and the entire satellite (prior to solar array deployment) measures approximately 22x22x34 cm. Communications to ground are planned with a space-qualified X-band transceiver and a ground station to be nominally located at a high latitude. Average power consumption of the satellite is approximately 50 W. This presentation will provide an overview of the EON-MW mission, discuss key satellite and payload subsystems, describe risk reduction and mission planning, and present key attributes of the ground and data segments.

Earth Observing Nanosatellite - Infrared

David Furlong (NESDIS / OPPA)

The CubeSat Infrared Atmospheric Sounder (CIRAS) will measure upwelling infrared radiation of the Earth in the MWIR region of the spectrum from space on a CubeSat. The observed radiances can be assimilated into weather forecast models and be used to retrieve lower tropospheric temperature and water vapor for climate studies. Multiple units can be flown to improve temporal coverage or in formation to provide new data products including 3D motion vector winds. CIRAS incorporates two new instrument technologies. The first is a 2D array of High Operating Temperature Barrier Infrared Detector (HOT-BIRD) material, selected for its high uniformity, low cost, low noise and higher operating temperatures than traditional materials. The detectors are hybridized to a commercial ROIC and commercial camera electronics. The second technology is an MWIR Grating Spectrometer (MGS) designed to provide imaging spectroscopy for atmospheric sounding in a CubeSat volume. The MGS has no moving parts and is based on heritage spectrometers including the OCO-2. JPL will also develop the mechanical, electronic and thermal subsystems for CIRAS. The spacecraft will be a commercially available CubeSat. The integrated system will be a complete 6U CubeSat capable of measuring temperature and water vapor profiles with good lower tropospheric sensitivity. The CIRAS is the first step towards the development of an Earth Observation Nanosatellite Infrared (EON-IR) capable of meeting the replacement needs of the CrIS on JPSS.

Early successes: CIRAS is based on the legacy sounder the Atmospheric Infrared Sounder (AIRS) on Aqua with new technologies developed by the DOD (HOTBIRD detectors) and the NASA Instrument Incubator Program (IIP) including the Spaceborne Infrared Atmospheric Sounder (SIRAS).

Anticipated Impacts: CIRAS will provide a significant reduction in the cost of future IR sounders and provide the ability to launch affordably and quickly to mitigate a gap in loss of capability or enhance capability.

Compact Coronagraph

Larry Zanetti (NESDIS / OPPA)

An innovative solar coronagraph designed specifically for the National Oceanic and Atmospheric Administration's coronal mass ejection (CME) imaging requirements is presented. The externally occulted compact coronagraph (CCOR) exploits the diffraction and coronagraph design technology experience, insight, and heritage of the Solar & Heliospheric Observatory (SOHO) Large Angle and Spectrometric Coronagraph (LASCO) as well as the Solar and Terrestrial Relations Observatory (STEREO) Sun Earth Connection Coronal and Heliospheric Investigation (SECCHI) outer coronagraph (COR2) and Heliospheric Imager (HI). CCOR also utilizes the state of the art active pixel sensor (APS) detector and electronics technology developed for the Solar Orbiter mission Heliospheric Imager (SoloHI) and the Solar Probe Plus mission Wide-field Imager (WISPR). As a result CCOR achieves an optical performance comparable to the traditional externally occulted Lyot design implemented in COR2 with a relatively simple, compact, low mass, and low power externally occulted design. In addition, and in contrast to COR2, CCOR is capable of obtaining useable CME velocity measurement data even during severe solar energetic particle storms that frequently accompany strong CME events. This presentation will describe the relevant CCOR design heritage derived from SOHO/LASCO, SECCHI/COR2, SPP/WISPR, and SoloHI and it will address the three key technology elements incorporated in the CCOR sensor that enable the compact and SEP tolerant design.

Cyclone Global Navigation Satellite System

Paul Chang (NESDIS / STAR)

The GNSS-R technique utilizes signals from the GPS satellite system and measures the forward scatter of the transmitted GPS signal off the earth's surface. From this forward scattered signal one can infer various environmental parameters.

Early successes: The TDS-1 carries a similar GNSS-R receiver that CYGNSS will employ and provided some initial space-based GNSS-R data that has been used in preparation for the CYGNSS mission. Otherwise, the CYGNSS mission will be the first real test of this technique to measure the ocean surface wind speed.

Anticipated Impacts: This very much depends upon what we learn from the CYGNSS mission, but in general this measurement technique might provide some wind speed information that could prove beneficial in supporting marine weather analysis, forecasting and warning.

Satellite Radar Altimetry In Transition

Walter H.F. Smith (NESDIS / STAR)

Satellite Radar Altimetry In Transition Walter H. F. Smith, Geophysicist, STAR Satellite altimeters are nadir-looking active radars that measure the height, roughness, and backscatter of the patch of area beneath them. Over oceans, their sea level, wave height, and wind speed data are used operationally by NOAA, Navy & Coast Guard. Over sea ice, land ice, and inland waters the data are used both operationally and in research. Jason-3, launched January 2016, is the last altimeter to use the classical measurement scheme that has been tried-and-true since the 1980s. ESA's CryoSat2 research mission launched in 2010 and Sentinel-3 operational mission launched in 2016, furnish data at a much higher rate, enabling more sophisticated processing on the ground. NOAA is a partner in Sentinel-6/Jason-CS, planned for a 2019 launch, which will furnish the higher rate data in an optimal way, thanks to NOAA leadership and STAR research. The operational processing used by CryoSat2 and Sentinel-3 and currently planned for Sentinel-6/Jason-CS makes only a limited exploitation of the new capability, applying a synthetic aperture ("SAR") calculation only over short (3 ms) bursts. This narrows the measurement area in the along-track direction to 300 m from the roughly 3 km achieved by classical altimeters such as Jason-3. NOAA STAR has developed "fully focused SAR altimetry", taking the SAR calculation all the way to 0.5 m along-track resolution. ESA and EUMETSAT are interested in adopting this technique operationally in the future. The above altimeters make their primary measurement in Ku band (13.6 GHz). SARAL (France/India, launched 2013) delivers Ka-band (35 GHz) altimeter data. All else being equal, Ka may yield better precision than Ku, though it may be more prone to data loss in rain. SARAL has performed well in most ocean conditions, and researchers are now comparing Ka and Ku performance over ice and snow. The joint NASA-CNES proposed SWOT mission would require coherent Ka-band SAR interferometry from antennas deployed on orbit, a technological challenge. If the challenge can be met, it might furnish detailed swaths of altimeter data useful for high-resolution ocean circulation modeling.

[Back to Session Profile](#)